



Limulines of the Mississippian Bear Gulch Limestone of Central Montana, USA

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Abstract. The limuline Merostomata of the Bear Gulch Limestone of the Mississippian of Montana are described. Two forms are recognized. *Paleolimulus longispinus* sp. nov. is the more frequent of the forms, and *Euproops* sp. occurs as only a few poorly preserved specimens.

INTRODUCTION

The invertebrates of the Mississippian Bear Gulch Limestone are known to contain malacostracan Crustacea (Schram and Horner, 1978), Annelida and other worm groups (Schram, *in press*), and conodont eaters (Melton and Scott, 1972; Scott, 1973), as well as pelecypods, gastropods, cephalopods, and articulate and inarticulate brachiopods. The fauna of the Bear Gulch Limestone is collected from several outcrops in Fergus County, near Beckett, Montana.

Two limuline merostomes have been found in the fauna. The more common of the two is a new species of *Paleolimulus* Dunbar, 1923. In addition, some material assignable to the genus *Euproops* Meek, 1867, is recognized, but the specimens are too poorly preserved to identify as to species.

Abbreviations: UM—University of Montana, Missoula; CM—Carnegie Museum of Natural History, Pittsburgh, Pennsylvania.

DISCUSSION

The merostome material is not particularly common in the Bear Gulch fauna as a whole. Twelve specimens of *Paleolimulus longispinus* are presently known. Only 1 specimen can be identified definitely as *Euproops*, but 2 other fragmentary specimens may be assignable here.

All specimens are generally preserved as molds, and/or texture differences in the rock with little actual relief. Specimens UM 5558, CM 33986, and CM 33987 do have some organic residues preserved but these contribute nothing to the understanding of the fossils as such. CM 33985 preserves a prosomal appendage as a color difference in the rock, a form of preservation common in the Carboniferous Lagerstätten.

In terms of faunal affinities, these merostomes verify what was seen in the crustacean (Schram and Horner, 1978) and worm (Schram, *in press*) elements of the Bear Gulch fauna. There is a close similarity to the Mazon Creek Essex fauna. *Paleolimulus* is the dominant merostome. *Euproops danae* is the characteristic limuline of the Mazon Creek fresh to brackish water Braidwood Fauna and rarely occurs in the nearshore marine Essex Fauna.

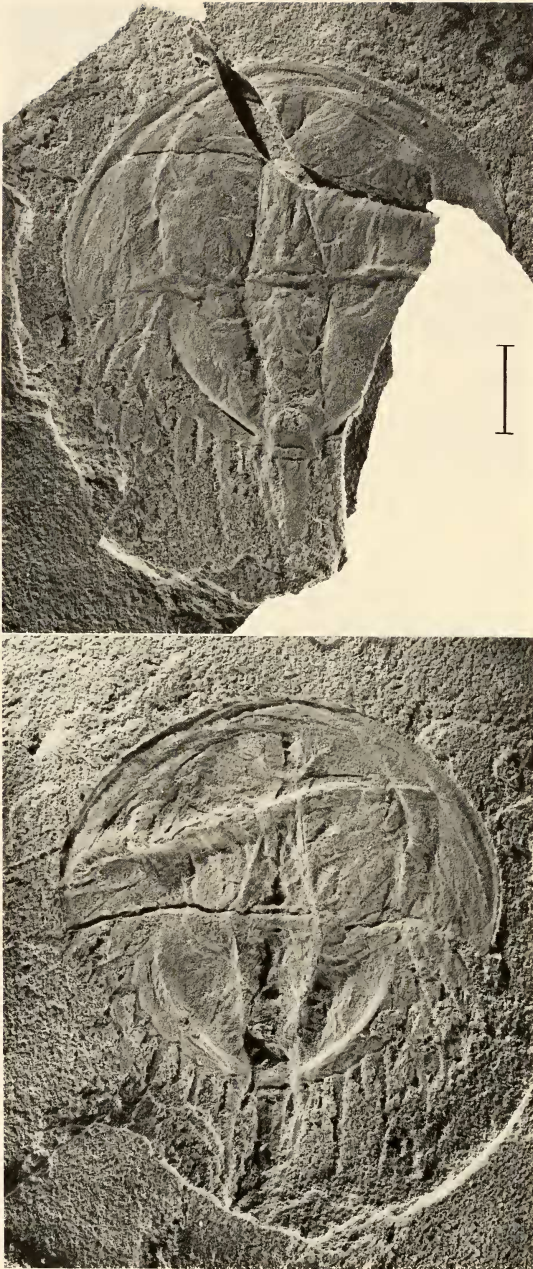


FIG. 1. *Paleolimulus longispinus* sp. nov., UM 5559, counterparts of holotype. Scale = 1 cm.

TABLE 1. Measurements (in centimetres) of *Paleolimulus longispinus*. *holotype.

Specimen	Prosoma		Opisthosoma		Telson length
	Length	Width	Length	Width	
UM 5559*	2.57	5.20	2.07	≈4.10	>1.66
CM 33946	2.54	...	1.84
CM 33947	2.87	5.55	1.87
CM 33983	2.75	5.23	1.88	3.55	>2.15
CM 33984	2.33	4.65	1.66	≈3.05	>1.60
CM 33985	2.78	4.24	1.65	3.25	...
CM 33994	...	5.48	2.17	3.60	5.45
CM 33995	2.90	...	2.35	...	3.98
CM 33996	2.30	4.72	1.82	3.28	...
CM 33997	2.92	...	≈2.0
CM 33998	2.67	...	2.20	≈2.90	...

SYSTEMATIC PALEONTOLOGY

Phylum Cheliceriformes Schram, 1978

Subphylum Chelicerata Haymons, 1901

Class Merostomata Dana, 1852

Subclass Xiphosura Latreille, 1802

Order Xiphosurida Latreille, 1802

Suborder Limulina Richter & Richter, 1929

Infraorder Limulicina Richter & Richter, 1929

Superfamily Limulacea Zittel, 1885

Family Paleolimulidae Raymond, 1944

Genus *Paleolimulus* Dunbar, 1923*Paleolimulus longispinus* sp. nov.*Holotype*.—UM 5559 (Fig. 1).*Other material*.—CM 33946, CM 33947, CM 33983–CM 33985, CM 33994–CM 34000.*Horizon and locality*.—as indicated in the Introduction.*Diagnosis*.—Ophthalmic ridges slight. Interophthalmic region broad, extending to near anterior prosomal margin. Slight genal spines. Opisthosoma rounded. Pretelsonic free segment flanked by spines from posterior of axial lobe. Eight or 9 marginal opisthosomal spines alternating in size. Telson very long.*Description*.—The ratio of prosomal width to length is 1.9:1. The interophthalmic area is broad and semicircular and extends to near the anterior margin of the prosoma. The eyes are not well preserved. The cardiac lobe is subtriangular, about $\frac{2}{3}$ the length of the prosoma, and is connected to the ophthalmic ridge by a faint anterior extension of the cardiac apex. Four faint muscle scar lobations flank the main cardiac lobe. The genal spines are small.

The opisthosoma is somewhat semicircular. The margin is developed as a shelf from which 8 or 9 spines are articulated. The spines alternate posteriorly in size between long and short. The axial lobe is narrower posteriorly than anteriorly. The lobe is produced posteriorly as 2 curved spines that flank the pretelsonic segment and extend beyond the posterior margin of the opisthosoma. The telson is moderately wide and very long, though seldom preserved in its entire length.

The holotype, UM 5559, and CM 33985 preserve portions of a prosomal appendage. Nothing is distinctive about them. They are chelate. The segment proximal to the chela on CM 33985 is quite long and the segment proximal to that is of indeterminate length.

Measurements of *P. longispinus* are given in Table 1, and a reconstruction is offered in Fig. 2.

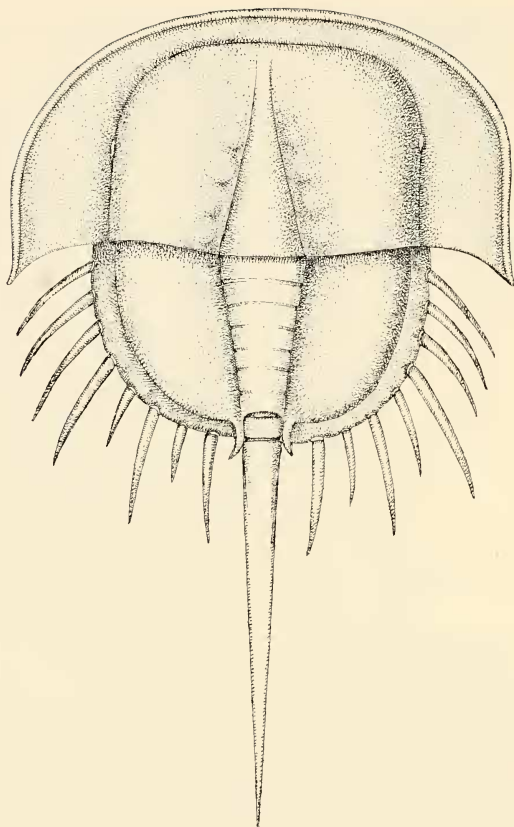


FIG. 2. *Paleolimulus longispinus* sp. nov. (reconstruction).

Remarks.—Dunbar (1923) described the genus and species *Paleolimulus avitus* from the Lower Permian Elmo Limestone Member of the Wellington Shale of Elmo, Kansas, USA. *Paleolimulus avitus* differs from *P. longispinus* in having somewhat longer and more outwardly directed genal spines. The ophthalmic ridges of *P. avitus* are very prominent and are bilobed, meeting with the apex of the cardiac lobe, and the interophthalmic area is relatively narrow. The opisthosoma is narrower and more elongate than that of *P. longispinus*, and there were apparently only 4 or 5 small marginal spines on the opisthosoma. The ratio of prosomal width to length of *P. avitus*, based on Dunbar's material and that of Raymond (1944), is 1.67:1.

A comparison of the known species of *Paleolimulus* is presented in Table 2. Dunbar (1923) included in the genus *Paleolimulus*, *P. signatus* (Beecher), 1904, and *P. randalli* (Beecher), 1902. *Paleolimulus signatus* is somewhat stratigraphically lower in the Fort Riley Limestone of Kansas than *P. avitus*. The single known specimen of *P. signatus* is an incomplete prosoma but it is $>3\times$ larger than that of *P. avitus*. The anatomy is very similar, however, and more and better material of these species may reveal that *P. avitus* is conspecific with *P. signatus*. *Paleolimulus randalli* is from the

TABLE 2. Comparison of the known species of *Paleolimnulus*. *P. avitus* and *P. signatus* may be conspecific.

Species	Prosoma (width: length)	Genal spines	Opisthosoma shape	Opisthosomal spines	Age
<i>P. longispinus</i>	1.90	Small	Rounded	8-9 alternate long and short posteriorly	Upper Mississippian
<i>P. signatus</i>	?	?	?	?	Lower Permian
<i>P. avitus</i>	1.67	Moderate-large	Elongate	4-5 short	Lower Permian
<i>P. randalli</i>	?	None	?	?	Upper Devonian
<i>P. juresanensis</i>	1.86	Moderate	Elongate	8 uniform	Upper Carboniferous



FIG. 3. *Euproops* sp., UM 5558. Note: prosoma is much broader than long and opisthosoma is segmented. Scale = 1 cm.

Upper Devonian Chemung Sandstone. It too is an incomplete prosoma but differs from any other *Paleolimulus* material in having an anteriorly narrow cardiac lobe and, although the posterior prosomal margin is quite concave, apparently no genal spines.

Finally, Chernyshev (1933) described *Paleolimulus juresanensis* from the Upper Carboniferous of the Urals on the Yurezan River. He had a single ventrally preserved specimen. As a result, it is difficult to compare *P. juresanensis* to the other species. The prosomal width to length ratio is 1.86:1. Although there are 8 marginal opisthosomal spines, the spines appear to be all the same length, and the opisthosoma is more elongate than rounded. As far as can be deduced, *P. juresanensis* appears to be a distinct species, though probably taxonomically closer to *P. longispinus* than the other species of *Paleolimulus*. But it should be remembered that dorsal preservations of the Soviet material are necessary before definitive taxonomic judgments can be made.

Superfamily Euproopacea Eller, 1938

Family Euproopidae Eller, 1938

Genus *Euproops* Meek, 1867

Euproops sp.

Material.—UM 5558, ?CM 33986, ?CM 33987.

Horizon and locality.—as indicated in the Introduction.

Remarks.—One specimen, UM 5558 (Fig. 3), seems to be definitely a member of the genus *Euproops*. Though the specimen is poorly preserved, several features allow it to be identified as a euproopid. The prosoma is markedly wider than long, with a width to length ratio of 2.8:1, and appears to bear carinate ophthalmic spines. The opisthosoma is clearly segmented across its entire width. In addition, CM 33986 and CM 33987 may also be euproopids based on shape of what appears to be the prosoma. But these latter 2 specimens are very poorly preserved.

The measurements of UM 5558 are: prosomal length, 2.03 cm; prosomal width, 5.66 cm; opisthosomal length, 2.42 cm; opisthosomal width, 3.63 cm.

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available for study. The reconstruction in Fig. 2 was executed by Tony D'Attilio of the San Diego Natural History Museum.

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